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ABSTRACT

Purposes of this study are to determine the effects of (1) preassessed dimensional salience upon performance in a bi-dimensional matching task, and (2) pretraining conditions expected to facilitate bi-dimensional processing. An additional aim was to elucidate a model of development involving changing salience hierarchies by comparing the effects of salience across three developmental levels. A matching salience assessment procedure was administered to 16 boys and 16 girls representing three developmental levels (nursery school, kindergarten, and first grade). A rank order salience hierarchy was assigned to each subject. The experiment was conducted approximately one month subsequent to salient assessment and utilized a 3 (developmental levels) X 2 (pretraining dimensions) X 2 (pretraining tasks) factorial design. Subjects were, on all tasks, required to identify from a set of four choice cards the "missing card" which was "most like" three sample cards. Although performance generally improved with age, small and nonsignificant developmental differences were obtained in the processing of more salient values. Developmental differences were primarily the result of differential evaluation and utilization of less salient information. Significant interactions establish that developmental differences, as well as less salient errors, were attenuated following relevant pretraining. Conclusions and implications are discussed. (Author/RH)

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The Effects of Dimensional Salience, Pretraining Task, and Developmental Level upon Bidimensional Processing in a Matching Task

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The Effects of Dimensional Salience, Pretraining Task, and Developmental Level upon Bidimensional Processing in a Matching Task

Major Purposes:

Previous studies have demonstrated that, across a wide variety of unidimensional problems, performance is superior when a highly salient, rather than a less salient, dimension is relevant to task solution. Although dimensional salience has been recognized as an important factor influencing unidimensional problem solving, the effects of salience upon bidimensional problem solving have been, largely, ignored. Nevertheless, it is conceivable that dimensional salience influences the distribution of attention across two, relevant dimensions. Therefore, one of the purposes of the present study is to determine the effects of preassessed dimensional salience upon performance in a bidimensional matching task.

Another purpose of the present study is to determine the effects of pretraining conditions expected to facilitate bidimensional processing. One variable, Pretraining Dimensions (either relevant or irrelevant for solution of the subsequent bidimensional transfer task), was included to determine whether prior problem solving experiences with relevant dimensions would facilitate subsequent bidimensional processing as would, reasonably, be expected if such pretraining successfully increased the salience of those dimensions. Another variable, Pretraining Tasks (either bidimensional or unidimensional), was included to determine whether or not information processing strategies, which would be expected to provide positive and negative transfer, respectively, could be induced.

Finally, an attempt is made to elucidate a model of development involving changing salience hierarchies by comparing the effects of salience across three developmental levels.

Methods and Procedure:

A matching (method of triads) salience assessment procedure was administered to 16 boys and 16 girls representing each of three Developmentals Levels (Nursery School, Kindergarten, and First-Grade). On the basis of the frequency of choices and reaction times to each of four dimensions, form, color, number, and position of items on cards, a rank-order salience hierarchy was assigned to each subject. (The most salient dimension within each subject's hierarchy is referred to as Dimension A, with Dimension B being the next most salient dimension, etc.)

The experiment was conducted approximately one month subsequent to salient assessment. Pretraining, administered to a criterion of eight successive correct responses, was followed by presentation of a bidimensional transfer task in which Dimensions A and D were relevant.

The experiment utilizes a 3 (Developmental Levels) X 2 (Pretraining Dimensions, either A and D or B and C) X 2 (Pretraining Tasks, either bidimensional or unidimensional) completely balanced, factorial design.

Subjects were, on all tasks, required to identify from a set of four choice cards the "missing card" which was "most like" three sample cards. Figure 1a shows the stimuli used on a unidimensional, form trial. Unidimensional pretraining consisted of a series of trials, on some of which Dimension A (or B) was relevant, while, on the remaining trials, Dimension D (or C) was relevant.

Figure 1b shows the stimuli used on one trial of a bidimensional, form-color task. As can be seen in the figure, the correct choice card contains the same form and color values as the sample cards. If the subject failed to select this card, the error was recorded as either a more salient (MS), a less salient (LS), or a combined MS and LS error, according to the relative salience of the dimension, or dimensions, which was (were) not utilized in matching.

Results:

Pretraining and transfer performances were, each, analyzed by means of 3 X 2 X 2 X 2 analyses of variance (the last factor, Error Type, being a within-subjects factor) performed upon errors to a criterion of 8 successive correct responses.

Table 1 presents the mean number of each pretraining Error Type (MS and LS) according to the independent variables, and lists the significant main effects and interactions obtained on the analysis of variance of pretraining errors. The most theoretically interesting finding was the significant Developmental Level X Error Type interaction. This revealed that, although performance generally improved with age, small and nonsignificant developmental differences were obtained in the processing of MS values. The developmental differences were, thus, primarily the result of differential evaluation and utilization of LS information.

Table 2 lists the significant main effects and interactions obtained on the analysis of bidimensional (AD) transfer task errors, and presents the mean number of each Error Type according to Developmental Level and Pretraining Dimensions. (The data is combined across Pretraining Tasks, as neither the main effect of this factor nor its interaction with any other factor was significant.) The significant Developmental Level X Pretraining Dimensions and Pretraining Dimensions X Error Type interactions establish that developmental differences, as well as LS (Dimension D) errors, were attenuated following relevant (AD) pretraining.

Conclusions and Implications:

That bidimensional processing can be facilitated by prior experience with relevant dimensions, regardless of the context of that experience, (i.e., whether in the course of unidimensional or bidimensional responding), demonstrates that, rather than the operation of different cognitive mechanisms (i.e., strategies), the primary factor accounting for obtained differences in bidimensional processing

is the differential saliences of the relevant dimensions. Hence, relevant pretraining reduced the frequency of LS (Dimension D) errors which, otherwise, resulted from the unidimensional evaluation of a highly salient dimension (Dimension A).

Similarly, although bidimensional processing generally improves with age, the present findings indicate that this improvement may be, primarily, the result of changing salience hierarchies (i.e., the increasing salience of initially less salient information). Since developmental differences are attenuated following relevant pretraining, developmental performance differences obtained without such pretraining may be attributable to differences in the information evaluated perceptually and, thus, made available to cognitive processes that are similar or identical across the ages considered.

If subsequent research demonstrates that performances on rule learning, conditional discrimination, or Piagetian conservation and matrix construction tasks are better predicted by dimensional salience hierarchies and/or pretraining such as demonstrated in this study than by developmental indices such as Age, then a perceptual-, rather than a cognitive-, change position would seem more persimonious in accounting for the major extant developmental differences in problem solving.

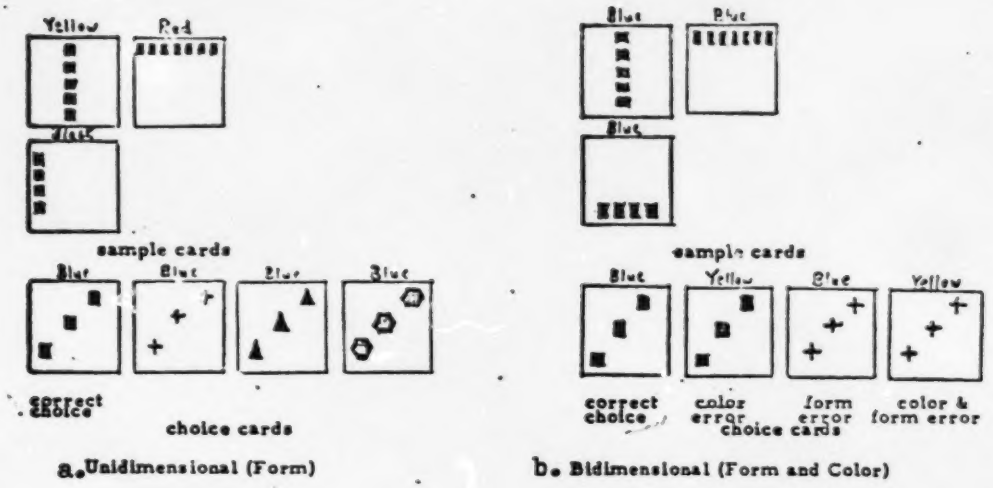

Fig. 1. An Example of a unidimensional and a bidimensional matching-to-samples trial.

Table 1

Errors on Pretraining according to Grade (N, K, or 1st), Dimensions (A and D or B and C), Task (Uni- or Bi-dimensional), and Error Type (MS or LS dimension)

Grade	Pretraining Dimensions: AD				BC			
	Pretraining Task: Uni-dimensional		Bi-dimensional		Uni-dimensional		Bi-dimensional	
	MS	LS	MS	LS	MS	LS	MS	LS
Nursery (N=32)	1.25	2.38	0.13	2.00	3.50	6.00	1.38	3.38
Kindergarten (N=32)	0.88	1.25	0.25	2.63	0	0.13	0.75	0.88
First Grade (N=32)	0.13	0.38	0.13	1.25	0	0.13	0.50	0.13

Developmental Level, $F(2,84) = 12.11$, $p < .01$
Developmental Level X Pretraining Dimensions, $F(1,84) = 5.76$, $p < .05$
Developmental Level X Pretraining Task, $F(1,84) = 3.21$, $p < .05$
Error Type, $F(1,84) = 12.95$, $p < .01$
Developmental Level X Error Type, $F(2,84) = 3.09$, $p < .05$

Table 2

Errors on Target (A-D) Task according to Grade, Pretraining Dimensions (AD or BC), and Error Type (Dim A or Dim D).

Grade	Pretraining Dimensions: AD, Error Type: Dim A (MS)	AD, Dim D (LS)	BC, Dim A (MS)	BC, Dim D (LS)
Nursery	0.25	1.19	1.75	5.06
Kindergarten	0.06	0.31	0.25	1.50
First Grade	0.13	0.31	0.19	1.63

Developmental Level, $F(2,84) = 8.16$, $p < .01$
Pretraining Dimensions, $F(1,84) = 14.$[illegible], $p < .01$
Developmental Level X Pretraining Dimensions, $F(2,84) = 3.55$, $p < .05$
Error Type, $F(1,84) = 16.60$, $p < .01$
Pretraining Dimensions X Error Type, $F(1,84) = 6.53$, $p < .05$

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